Education

Studies on some heavy metals and using of some selected phyco-chemical parameter in Zuru Dam, Kebbi State, Nigeria

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Abstract

The study was conducted to assess the levels of concentration and apportionment of Pb, Cr, Fe, Cd, Co, Ni, Zn and Cu and some physicochemical parameters include Temperature, pH, DO and TDS of Zuru dam were assessed for 8 months (January, 2019-August, 2019). The main acquired data was the water from the lower and the upper regions of the dam. The samples were collected and prepared in the laboratory according to standard method, Atomic Absorption Spectrophotometer (AAS) technique was used to analyze the data. The results showed concentration of Pb, Cr, Fe, Cd, Co, Zn and Cu at various levels. The results also showed the distribution of these elements at lower and upper regions of Zuru dam. The enrichment of these heavy elements in the dam could be due to loading of the dam with scattered materials and effluents generated by various human activities within the dam feature area through overland and base flows and the release of elements from geologic processes. The concentration of Pb, Cr and Fe were observed to be slightly above. The parameters fluctuated throughout the study period with maximum values recorded mostly hermatan and rainy season. Temperature was negatively correlated to TDS and increase in pH was observed to moderately reduced. To minimize pollution of the dam, it is strongly recommended that there should be reduction in levels of some unhealthy practices such as making release of effluents like, engine oil; lubricants, used batteries, any electric wastes; electronic and electrical appliances and high level use of chemicals on the farms are suggest to be disheartened.

Keywords: zuru dam, concentration, heavy elements, human activities, lower region, upper region

Introduction

Heavy elements are those metallic elements with high atomic weight that is at least five times greater than that of water (Ada *et al.*, 2012) [4]. Heavy elements include; lead (Pb), cadmium (Cd), zinc (Zn), mercury (Hg), arsenic (As), silver (Ag), chromium (Cr), copper (Cu), iron (Fe) and the platinum group elements (Dorherty *et al.*, 2012) [10]. They are non-biodegradable and persistent environmental contaminants which may be deposited in water bodies. The presence of heavy metals in the aquatic environment in trace concentration is important for normal development of the organism (Kosi – Siakpere and Ubogu, 2008) [14]. They could be detected in the aqueous medium and in the bottom. Some heavy metals are completely toxic and need to be monitored continuously in the bodies of organisms as they are capable of bioaccumulation, resulting to mobility and often mortality of the organisms (Ayotunde *et al.*, 2011) [6].

Ayotunde *et al.*, (2011) [6] observed that when heavy metals enter aquatic environment a great portion settles and is absorbed by the bottom mud (sediment). They could also be recycled by chemical and biological processes such that some quantities remain dissolved in the water column and some part is being absorbed by the inhabitants (Ada *et al.*, 2012) [5]. Interest in the environmental levels of heavy elements is a global one because of the potential hazards of these metals to the health of humans, animals and plants when they exist at elevated levels. Swayer *et al.*, (2006) [21] is of the opinion that heavy elements are dangerous because they bioaccumulation and interfere with biochemical processes in the living issues.

High levels of heavy metals in soil, water and atmosphere vis-à-vis the biota are often related to industrial activities, burning of fossil fuels, chemical dumping, application of agro-allied chemicals such as fertilizer and certain pesticides (Oyekunle *et al.*, 2012) [18]. The knowledge of the levels of heavy elements in our environment is necessary for the purposes of setting background values of these elements, monitoring their accumulation in the biota regularly and estimating the amount of the metals that may possibly get translocated across the compartments in the entire ecosystem (Oyekunle *et al.*, 2012) [18]. Harrison (1996) [11] observed that with increasing industrial activities, what were once pristine habitats of organisms are becoming increasingly exposed to environmental pollution by heavy metals. Long human-induced generation of heavy metals continues in industrial and domestic activities, sustained measurement will be needed to assess the effectiveness of the set limitation standards and facilitate the identification and quantification of the state of environmental degradation attributable to the discharged-heavy metals.

The quality of water is of vital concern for mankind because it directly linked with human health (Abdulazeez, 2015) [2]. Freshwater has become a scare commodity due to over exploitation and pollution (Muhammad and Saminu, 2012).

Pollution is caused when a change in the physical, chemical or biological condition in the environment harmfully affect quality of human life including other animals and plants' life (Oketola *et al.,* 2006). Industrial, sewage municipal wastes are been continuously added to water bodies hence affect the physiochemical quality of water making them unfit for use of livestock and other organism (Abubakar and Abdullahi, 2015). According to Ibrahim (2009) [25] Water resources are of critical importance to both natural ecosystem and human development. It is essential for agriculture, industry and human existence. The healthy aquatic ecosystem is depended on the physicochemical and biological characteristics (Verma *et al.,* 2012). The quality of water in any ecosystem provides significant information about the available resources for supporting life in that ecosystem (Ibrahim, 2008) [24]. Good quality of water resources depends on a large number of physic- chemical parameters and biological characteristics to assess the monitoring of these parameters is essential to identify magnitude and source of any pollution load (Adesalu *et al.,* 2010) [3]. Due to increased population and use of fertilizers in agriculture and man-made activities, the natural aquatic environment is increasingly polluted leading to depletion of aquatic biota and water quality (Adakole *et al*., 2008 and Kawo *et al*., 2008). Impairment of water quality in reservoirs arises largely from anthropogenic contamination and natural mineralization (APHA, 1995 and Adamu *et al.,* 2014) [1]. The physical and chemical parameters serve as pollution indicators in water quality monitoring which is a fundamental tool in the management of fresh water resources (Balarabe 2001).

Materials and methods

Study area

Zuru is located on latitude 11.447616 N longitude 5.230179° E.

Water sampling

Water samples were collected for 8 months from the 3 sampling stations and taken to the Agriculture Physical laboratory of Usmanu Danfodio University Sokoto, Sokoto State, for some of the physico-chemical parameters and heavy metal concentration analysis. Each sample was filtered in the laboratory using Watman Brand filter paper of 0.45um to remove clay and other suspended colloids in the water sample. 100ml of the filtered sample was collected and stabilized with Nitric acid in each sample. The standard curves of Pb, Cr, Fe, Cd, Co, Ni, Zn and Cu were prepared bearing in mind that these elements occur in trace concentration. Standard solutions were prepared from 1000 parts per million (ppm) stock solutions. 1ml of the 1000 ppm was pipette into 100ml volumetric flask and made up with distilled water. This solution was 10 ppm of the solution. Temperature, dissolved oxygen and pH were measured *in-situ*.

Statistical analysis

Data collected was subjected to analysis of variance (ANOVA) and Duncan Multiple Range Test was used to separate the means where there was significant difference.

Results and discussion

The results of the analysis as shown on Tables 1 and 2 showed the levels of concentration and distribution of some heavy elements in Zuru dam. The result showed that the levels of concentration of Pb at the lower and upper regions of the dam are both high with low standard deviation, Water quality as shown on Table 3. Lead is a chemical element in the carbon group. Immoderate intakes of Pb can intact nervous system and cause brain disorder. Pb is a neurotoxin that proliferates both in soft tissues and the bones (Wikipedia, 2013).

The level of mixture of Cr in the entire Zuru dam is high as shown on Tables 1 and 2, both the standard in the upper region is low, however they are high in the lower region.

Table 3: Cr is one of the trace elements that found as an exuberant element in the earth crust, its lexemes are found in the ecosystem due to erosion of chromium containing rocks and from other man-made sources. Excessive exposure to Cr is suspected to be carcinogenic because of its bioaccumulation nature.

The concentration of Fe in Zuru dam is high, both the standard deviation at the lower region is low, but high at the upper region. The Zuru area contained a lot of biotitic rocks which release Fe through weathering into the drainage basin. High concentration of Fe in drinking water may cause turbidity, laundry and cooking materials; Fe has little direct and adverse health implications to humans but rather plays an important role in biology (Butu, 2012) [7].

The concentration of Cd in the entire dam occurs as a minor component in most Zn ores and therefore a by-product of Zn production. It is a rare element, it is used as pigment and corrosion resistant plating, and it could also be used as nickel-cadmium batteries. Cd has no biological function in humans, but it could be toxic to the kidney when consumed in quantities above permissible limits (Wikipedia, 2013).

The level of concentration of Co in the dam is relatively high considering the fact that Co is a trace element that occurs only in combination with other minerals in the soil. Both the standard deviation and the coefficient of variation at the lower region are high, but low in the upper region. Although there are no guidelines limits for Co in drinking water, MOE (2001) [16] reports that the toxicity of Co is quite low compared to other elements in the soil, however exposure to higher levels can be carcinogenic to humans because of the bioaccumulation nature of Co in the human tissues.

Table 4: The result of the study indicated maximum temperature and dissolved oxygen during dry and rainy seasons respectively. Highest biological oxygen demand was recorded after the rainy season while maximum value for hydrogen carbonates was obtained both during and after the rainy season. Meanwhile the highest concentrations after the rainy season perhaps due to excessive run-off into the dam, although the values still fall within the permissible levels as reported by. Temperature was negatively correlated to TDS, increase in pH was also observed to moderately decrease the levels.

Table 1: Concentration of selected heavy elements in the lower region of Zuru Dam

Heavy elements	Highest Concentration (ppm)	Lowest Concentration (ppm)	Mean Concentration	Standard Deviation
Lead (Pb)	0.271	0.100	0.217	0.050
Chromium (Cr)	0.583	0.004	0.286	0.066
Iron (Fe)	2.641	0.557	1.112	0.305
Cadmium (Cd)	0.003	0.001	0.0005	0.0001
Cobalt (Co)	0.061	0.029	0.051	0.034
Nickel (Ni)	-0.0020	-0.0002	-0.003	-0.0001
Zinc (Zn)	0.168	0.010	0.121	0.0021
Copper (Co)	0.174	0.058	0.108	0.053

Table 2: Concentration of selected heavy elements in the upper region of Zuru Dam

Heavy elements	Highest Concentration (ppm)	Lowest Concentration (ppm)	Mean Concentration	Standard Deviation
Lead (Pb)	0.221	0.042	0.160	0.050
Chromium (Cr)	0.834	0.039	0.340	0.208
Iron (Fe)	6.836	0.588	2,730	1.794
Cadmium (Cd)	0.001	0.000	0.0001	0.00001
Cobalt (Co)	0.957	0.002	0.169	0.142
Nickel (Ni)	-0.029	-0.010	-0.021	-0.004
Zinc (Zn)	0.450	0.011	0.126	0.048
Copper (Cu)	0.322	0.038	0.139	0.085

Table 3: Comparison of observed values of concentration of selected heavy elements in Zuru Dam

Heavy Elements	Lower Region	Upper Region
Lead (Pb)	0.119	0.121
Chromium (Cr)	0.216	0.310
Iron (Fe)	2.117	2.320
Cadmium (Cd)	0.0001	0.0001
Cobalt (Co)	0.161	0.165
Nickel (Ni)	-0.012	-0.022
Zinc (Zn)	0.160	1.36
Copper (Cu)	0.219	0.129

Table 4: Mean physico-chemical parameters of Zuru Dam

Parameter	Jan, 2019	Feb, 2019	March, 2019	April, 2019	May, 2019	June, 2019	July, 2019	Agust, 2019
Temp	23.27±0.06	24.22±0.01	25.35±0.01	25.52±0.01	27.65±0.50	26.76±0.50	28.54±0.10	25.67±0.50
pH	5.51±0.01	6.35±0.110	6.57±0.10	6.70±0.10	6.75±0.50	6.34±0.50	6.46±0.50	6.21±0.10
DO	6.57±0.12	6.11±0.10	6.54±0.10	6.65±0.15	6.75±0.10	7.11±0.10	6.52±0.50	6.27±0.10
BOD	25.00±0.01	23.45±0.50	18.57±0.50	21.15±0.10	19.55±0.10	20.47±0.50	20.27±0.50	22.56±0.50
TDS	6.67±0.56	5.44±0.50	6.43±0.50	5.21±0.50	5.77±0.10	4.78±0.10	4.81±0.10	3.25±0.50

The level of concentration of Ni in Zuru dam is far below detectable level. Therefore, the dam is free of Ni contamination. The results of the analysis showed a low concentration of Zn with low standard deviation in entire Zuru. The level of concentration of Cu in Zuru dam is low with low standard deviation in the lower region, but higher standard deviation in the upper region.

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